NUCLEAR SCIENCE AND ENGINEERING®

THE RESEARCH JOURNAL OF THE AMERICAN NUCLEAR SOCIETY

ANS OFFICERS

Joseph R. Dietrich
president

William R. Kimel
vice president/president elect

Kaye D. Lathrop
treasurer

Raymond D. Maxson
assistant treasurer

Octave J. Du Temple
executive director

ANS PUBLICATIONS STAFF

Norman H. Jacobson
publications manager

Joann Hollensteiner
editorial coordinator

Nancy Zacha Godlewski
copy editor

Diane R. Wojciechowski
copy editor

Siegfried H. Krapp
production manager

COMPOSITION

Beljan, Dexter, Michigan 48130

DIXON CALLIHAN, *Editor*

MELVIN L. TOBIAS, *Associate Editor*

MARGE WILLIAMS, *Administrative Assistant*

Union Carbide Corporation
Nuclear Division
Oak Ridge, Tennessee 37830

KARL WIRTZ, *Associate Editor, Europe*

ANTON BAYER, *Editorial Assistant*

Kernforschungszentrum Karlsruhe
D-7500 Karlsruhe
Postfach 3640
Germany

Editorial Advisory Committee

Manson Benedict
E. Richard Cohen
E. C. Creutz
Frank G. Dawson
D. H. Gurinsky
A. F. Henry
C. H. Millar
L. W. Nordheim
Hugh C. Paxton
Fred W. Thalgott

Volume 63
May, June, July, August 1977

Indexed in "Engineering Index" and Abstracted in "INIS Atom Index"

NUCLEAR SCIENCE AND ENGINEERING is published monthly by the American Nuclear Society, Inc., with business and executive offices at 555 N. Kensington Avenue, La Grange Park, Illinois 60525; telephone 312/352-6611. The subscription rate is $54 per volume or $144 for three volumes per calendar year. Single copy price is $19.50 for current and back issues. Microfiche subscriptions are also available at the same rates. Inquiries about the distribution and delivery of NUCLEAR SCIENCE AND ENGINEERING and requests for changes of address should be directed to the American Nuclear Society. Allow 6 weeks for a change to become effective. NUCLEAR SCIENCE AND ENGINEERING is printed in Danville, Illinois 61832, by Interstate Printers and Publishers, Inc. Second-class postage is paid at La Grange Park, Illinois, and at additional mailing offices.

Copyright © 1977 by the American Nuclear Society, Inc. Trademark registered in Canada.

Findings reported and opinions expressed in this publication by the authors are their own and do not necessarily reflect the opinions of the editors, the American Nuclear Society, or the organizations with which the authors are affiliated, nor should publication of author viewpoints or identification of materials or products be construed as endorsement by this publication or the Society. Address all manuscript and editorial communications to the editorial offices, NUCLEAR SCIENCE AND ENGINEERING, Building 9204-1, P. O. Box Y, Oak Ridge, Tennessee 37830. European authors send communications to Karl Wirtz, Kernforschungszentrum Karlsruhe, 75 Karlsruhe, Postfach 3640, Fed. Rep. of Germany.

Copyright © 1977 by American Nuclear Society, Inc., La Grange Park, Illinois 60525

Contents of Volume 63

VOLUME 63, NUMBER 1, MAY 1977

TECHNICAL PAPERS

1	Iterative and Direct Approaches to the Critical Dominant Eigenfunction in Three-Dimensional Neutron Transport	*F. Premuda, G. Spiga*
9	Monte Carlo Treatment of Fundamental-Mode Neutron Leakage in the Presence of Voids	*Ely M. Gelbard, Richard Lell*
24	Neutron Wave Propagation Across a Temperature Discontinuity	*Ashok Kumar, N. K. Saxena, L. S. Kothari*
31	Neutron Kinetics of Highly Compressed Fissionable Pellets	*J. Ligou*
41	Origin of Protons in Californium-252 Fission	*John A. Adams, R. R. Roy*
48	Neutron and Gamma Radiation from a Nitrogen Sphere Surrounding a D-T Neutron Source	*G. S. Sidhu, W. E. Farley, L. F. Hansen, T. Komoto, B. Pohl, C. Wong*
55	A Comparison of the Gamma-Ray Spectra from 2.8-keV Neutron Capture and Thermal-Neutron Capture in Sodium-23	*W. M. Wilson, H. E. Jackson, G. E. Thomas*
63	Structure-Fluid Interaction Between a Vibrating Wall and Flow in a Channel	*R. A. Bajura, A. H. Mace, Jr.*
75	Steady-State Natural Circulation Performance of the Experimental Breeder Reactor II Primary Heat Transport Circuit	*Ralph M. Singer, Jerry L. Gillette, Gerald H. Golden, Dale Mohr, Wayne K. Lehto, Charles C. Price, John I. Sackett*
83	The Effect of Niobium Additions on the Corrosion Behavior of Zircaloy-4	*G. P. Sabol, S. G. McDonald*

(Continued)

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 1, MAY 1977

(Continued)

TECHNICAL NOTES

91	Selection of Angular Quadrature for Anisotropic Transport Computations	*Wayne J. Mikols, J. Kenneth Shultis*
95	On the Inverse Problem for Multigroup Neutron Transport Theory	*C. E. Siewert, M. N. Özişik, Y. Yener*
96	Rapid Method of Calculating the Fluence and Spectrum of Neutrons from a Critical Assembly and the Resulting Dose	*Joseph Bessis*
101	Neutron-Induced Gamma-Ray Production in Lead-208 for Incident-Neutron Energies Between 4.9 and 8.0 MeV and in Bismuth-209 for an Incident-Neutron Energy of 5.4 MeV	*J. K. Dickens*

BOOK REVIEW

110	The Kinetics of the Oxidation-Reduction Reactions of Uranium, Neptunium, Plutonium, and Americium in Aqueous Solutions, T. W. Newton	*R. C. Thompson*

111 CORRIGENDUM

112 ANNOUNCEMENT OF CURRENT PUBLICATIONS

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 2, JUNE 1977

TECHNICAL PAPERS

119	Natural Convection in Porous Media with Heat Generation	*H. C. Hardee, R. H. Nilson*
133	Release of Adsorbed Krypton and Xenon from Spilled Charcoal	*Dwight W. Underhill*
143	Neutron Capture Cross Section of Plutonium-240	*L. W. Weston, J. H. Todd*
149	A Measurement of the Fission Cross Section of Plutonium-241 from 8 eV to 70 keV	*G. W. Carlson, J. W. Behrens, J. B. Czirr*
153	Measurement of the Uranium-238 Subthreshold Fission Cross Section for Incident Neutron Energies Between 0.6 and 100 keV	*F. C. Difilippo, R. B. Perez, G. de Saussure, D. K. Olsen, R. W. Ingle*
167	Solution of the Finite Element Diffusion and P_1 Equations by Iteration	*E. T. Tomlinson, J. C. Robinson*
179	Exponential Supplementary Equations for S_N Methods: The One-Dimensional Case	*P. Barbucci, F. Di Pasquantonio*

TECHNICAL NOTES

188	Laminar Heat Transfer Data with a Step-Varying Wall Heat Flux	*Otto I. Reisman, Robert O. Parker*
191	The Trapping Efficiency of Molten Lithium for 20-keV Tritium Ions	*Albert K. Fischer, David V. Steidl, Charles E. Brient, Fred A. Cafasso, Carl E. Johnson*
193	High-Resolution Gamma-Ray Spectrum from Concrete	*S. K. Gupta*
197	Cross Section for the Production of Beryllium-7 from Lithium-6, Lithium-6 Interactions	*Lawrence Ruby, Robert V. Pyle, Yue-Chau Wong*
198	Fission Cross Section of Berkelium-249 Between 0.7 and 3.0 MeV	*M. G. Silbert*
200	Hydrogen and Helium Production Cross Sections for 15-MeV Neutrons on Types 316 and 304 Stainless Steel	*R. C. Haight, S. M. Grimes, J. D. Anderson*

(Continued)

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 2, JUNE 1977

(Continued)

204	Accurate Approximations to Average Beta-Particle Energies and Spectra	*M. G. Stamatelatos, T. R. England*
208	Monte Carlo Calculations of Cadmium Cutoff Energies and an Ansatz Formula	*S. Fiarman, R. Sher*
213	Wigner-Type Continuous Slowing Down Theory for the Fast-Neutron Spectrum	*Yasunori Yamamura, Tamotsu Sekiya*
217	Discrete Neutron Decay Constants Above the Corngold Limit for Infinite Slabs	*N. G. Sjöstrand*

LETTERS TO THE EDITOR

219	Spatial Channel Theory	*A. B. Chilton*
220	The Relations Between Various *Contributon* Variables Used in Spatial Channel Theory	*M. L. Williams*

221 ANNOUNCEMENT OF CURRENT PUBLICATIONS

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 3, JULY 1977

TECHNICAL PAPERS

225 A Comparison of Constrained Finite Elements and Response Matrices as One-Dimensional Transport Approximations — *L. L. Briggs, E. E. Lewis*

236 Elastic Neutron Scattering from Distributed Fusion Neutrons, Deuterium, Tritium, and Lithium, and Multigroup Rate Coefficients — *B. R. Wienke, R. E. Seamon*

242 Calculated Neutron Capture Cross Sections to the Americium Ground and Isomeric States — *F. M. Mann, R. E. Schenter*

250 Measurements of the Neutron-Induced Fission Cross Sections of ^{234}U, ^{236}U, and ^{238}U Relative to ^{235}U from 0.1 to 30 MeV — *J. W. Behrens, G. W. Carlson*

268 Measurement of the $^{58}Ni(n,p)^{58}Co$ Cross Section with $H(n,n)p$ as a Standard — *Mien-Win Wu, Jen-Chang Chou*

276 Uncertainties in Fission Product Decay-Heat Calculations — *F. Schmittroth, R. E. Schenter*

292 Thermal-Neutron Behavior in Cluster-Type Plutonium Fuel Lattices — *T. Wakabayashi, Y. Hachiya*

306 Theoretical Investigation of the Local and Global Components of the Neutron-Noise Field in a Boiling Water Reactor — *K. Behringer, G. Kosály, Lj. Kostić*

319 Effects of Fast-Neutron Irradiation and High-Intensity Magnetic Fields upon Cavitation Thresholds and Nuclei Spectra in Water — *E. Yilmaz, F. G. Hammitt*

330 Determination of the Probing Distance in Pulsed-Neutron Uranium Logging Experiments — *James H. Renken*

TECHNICAL NOTES

336 A Parametric Analysis of the Spallation Breeder — *A. A. Harms, C. W. Gordon*

341 The Tritium Production in a Controlled Thermonuclear Reactor Blanket Model with a Graphite Reflector — *R. Herzing, L. Kuijpers, P. Cloth, D. Filges, R. Hecker, N. Kirch*

(Continued)

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 3, JULY 1977

(Continued)

343	Thermonuclear Reaction Rate Parameters for $d + {}^{6}Li$ Reactions	*A. J. Elwyn, J. E. Monahan, F. J. D. Serduke*
347	A Perturbation Analysis of Changes in Prompt Fission Neutron Uranium-Logging Signals Produced by Trace Neutron-Absorbing Rock Constituents	*James H. Renken*
350	Solidification of a Sphere with Internal Heat Generation and Convective Cooling at the Surface	*Vijay K. Dhir, Kin Wong, W. E. Kastenberg*

LETTERS TO THE EDITOR

357	Comments on Particle Transport in Finite Slabs	*M. M. R. Williams*
358	Reply to "Comments on Particle Transport in Finite Slabs"	*Stanley Woolf, John C. Garth, William L. Filippone*

COMPUTER CODE ABSTRACT

359	WASP2	*D. A. Spragg, C. S. Caldwell, F. T. Dunckhorst, G. W. Swartele*

360 ANNOUNCEMENT OF CURRENT PUBLICATIONS

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 4, AUGUST 1977

TECHNICAL PAPERS

365	Nonequilibrium Critical Discharge of Saturated and Subcooled Liquid Freon-11	*Michael R. Prisco, Robert E. Henry, Michael N. Hutcherson, John L. Linehan*
376	Estimation of Nuclear Decay Heat for Short-Lived Fission Products	*Tadashi Yoshida*
391	Neutron Thermalization Spectrum in a Partially Hydrogenated Terphenyl: Evaluation of Scattering Kernels for Organic Reactor Coolant	*H. Alan Robitaille, John S. Hewitt*
401	Double-Differential Beryllium Neutron Cross Sections at Incident Neutron Energies of 5.9, 10.1, and 14.2 MeV	*D. M. Drake, G. F. Auchampaugh, E. D. Arthur, C. E. Ragan, P. G. Young*
413	Thermal-Neutron Capture and Fission Cross Sections and Resonance Integrals for Curium-243	*C. E. Bemis, Jr., J. H. Oliver, R. Eby, J. Halperin*
418	High-Resolution Fast-Neutron Gamma-Ray Production Cross Sections for Iron up to 2100 keV	*W. E. Kinney, F. G. Perey*
430	A Reconciliation of Measurements of $\bar{\nu}_p$ for Neutron-Induced Fission of Uranium-235	*J. W. Boldeman, J. Fréhaut, R. L. Walsh*
437	Coarse-Mesh Flux-Expansion Method for the Analysis of Space-Time Effects in Large Light Water Reactor Cores	*S. Langenbuch, W. Maurer, W. Werner*
457	Some Basic Properties of the Response Matrix Equations	*Zbigniew Weiss*

TECHNICAL NOTES

493	Measurements of Energy Spectra and Doses in Liquid Air of Neutrons from a Californium-252 Source	*K. Clausen, U. Roose, P. Schneider-Kühnle, F. W. Buchholz, L. Schänzler, S. Stüker, G. Tumbrägel, M. Weinert*
500	Space- and Angle-Dependent Steady-State Thermal-Neutron Spectra Inside Small Beryllium Assemblies: II	*Suresh Garg, Feroz Ahmed, L. S. Kothari*

(Continued)

Contents of Volume 63

(Continued)

VOLUME 63, NUMBER 4, AUGUST 1977

(Continued)

504	Distribution of Fission Yields for Fission Spectrum Neutron-Induced Fission of Uranium-238	*D. C. Harris, J. N. Beck, W. L. Raines, J. T. Harvey, K. G. W. Inn, J. L. Meason, H. L. Wright*
507	Two-Half-Space Milne Problem in Two-Group Neutron Transport Theory	*Yuji Ishiguro, José Rubens Maiorino*
509	Upper-Bound Estimation of Bilinear Functionals in Reactor Theory	*Yigal Ronen, Ehud Greenspan*

BOOK REVIEW

514	Neutron Activation Tables, Gerhard Erdtmann	*V. Krivan*

515 CORRIGENDUM

516 ANNOUNCEMENT OF CURRENT PUBLICATIONS

523 VOLUME 63 AUTHOR AND SUBJECT INDEXES